Global Journal of Engineering Innovations & Interdisciplinary Research

Original Article

Vehicle Maintenance System and Service Queue Optimization

Suresh L[1], Bhargavi S[2], Snehanjali P[2], Prashanth S[2], Boni N[2]

[1]Assistant Professor, Department of CSE, Christu Jyothi Institute of Technology & Science, Jangaon, Telangana, India
[2]UG Students, Department of CSE, Christu Jyothi Institute of Technology & Science, Jangaon, Telangana, India

Correspondence

Suresh L

Assistant Professor, Department of CSE, Christu Jyothi Institute of Technology & Science, Jangaon, Telangana, India

- Received Date: 25 Jan 2026
- Accepted Date: 14 Mar 2026
- Publication Date: 20 Mar 2026

Keywords

vehicle maintenance system, service queue optimization, queueing theory, waiting time reduction, service efficiency, real-time monitoring, maintenance tracking, downtime minimization, service prioritization, appointment scheduling, demand forecasting, mechanic assignment.

Abstract

The Vehicle Maintenance System and Service Queue Optimization is a software solution designed to streamline the management of vehicle maintenance, repair scheduling, and service tracking. The system helps vehicle owners, workshops, and service centers to efficiently to monitor the condition of vehicles, predict maintenance needs, and manage service operations. This project aims to automate traditional manual processes by maintaining a digital record of vehicle details, repair history, mechanic details and service schedules. The system can predict potential failures and suggest preventive maintenance, reducing downtime and repair costs .The system provides features such as booking service appointments, tracking repair progress, managing spare parts inventory, generating maintenance reports, and notifying users about upcoming service dates. For workshops, it optimizes the service queue and resource allocation to enhance operational efficiency. Overall, the Vehicle Repair and Maintenance System improves reliability, reduces manual errors, saves time, and ensures better vehicle performance.

Introduction

Vehicle maintenance and servicing are essential for keeping vehicles safe, reliable, and long- lasting. As the number of vehicles on the road continues to increase, service centers often face challenges in handling large numbers of customers efficiently. Common problems include long waiting times, poor scheduling, unclear job assignments, and difficulty managing customer and mechanic details. These issues can lead to delays, errors, and unsatisfied customers. A vehicle maintenance and service queue optimization system is designed to make this process smoother and more efficient. The system keeps records of customer details such as name, contact number, vehicle type, registration number, and service history. It also stores mechanic details like name, specialization (for example, engine repair, electrical work, or bodywork), experience level, and availability. When a customer brings a vehicle for service, the system automatically registers the request and adds it to the queue. Instead of following a simple first- come, first- served rule, the system analyzes various factors—such as the type of service needed, the mechanic's skills, estimated service time, and workload—and then assigns the job to the most suitable mechanic. This optimization helps in several ways: Reduces customer waiting time, Ensures that skilled mechanics are assigned to appropriate tasks, balances workload among mechanics, Keeps track of each vehicles maintainance history for future reference , improves communication between customers, service managers, and mechanics.

Background

With the increasing number of vehicles, the demand for efficient maintenance services has also increased. Many service centers still rely on manual systems such as paper records and manual queue management, which are time-consuming and prone to errors. Customers often face long waiting times due to poor scheduling and lack of proper service management.

Advancements in information technology have made it possible to develop systems that automate service management processes. A Vehicle Maintenance System can help service centers maintain accurate records of vehicles, schedule service appointments, track service history, and manage spare parts. Additionally, queue optimization techniques help reduce waiting time and improve service efficiency by organizing the order in which vehicles are service

Problem Statement

A Vehicle Maintenance System and Service Queue Optimization is designed to manage and improve the process of vehicle servicing in workshops or service centers. In many service stations, vehicle maintenance activities such as registration, service requests, repair tracking, and delivery are handled manually. This often leads to problems such as long waiting times, poor scheduling, lack of proper records, and difficulty in managing multiple vehicles at

Citation: Suresh L, Bhargavi S, Snehanjali P, Prashanth S, Boni N. Vehicle Maintenance System and Service Queue Optimization. GJEIIR. 2026;6(3):0172.

the same time. Customers may face delays because vehicles are not serviced in an organized order, and service managers may struggle to monitor the workload of technicians and the availability of resources. The main problem is the inefficient handling of service queues and maintenance records, which reduces the overall productivity of the service center. Without a proper system, it becomes difficult to track vehicle history, assign tasks to technicians, estimate service completion time, and notify customers about the service status. This situation can lead to customer dissatisfaction and operational delays.

Literature Survey

A review of existing literature on vehicle maintenance systems and service queue optimization reveals significant advancements in both predictive analytics and operational efficiency models. Traditional maintenance strategies such as reactive and preventive maintenance have gradually evolved into predictive maintenance systems that utilize machine learning and deep learning techniques to forecast failures and optimize maintenance schedules, thereby reducing downtime and operational costs. Research on fleet maintenance optimization emphasizes multi-objective approaches, where factors like cost, safety, and resource utilization are simultaneously optimized using algorithms such as evolutionary and stochastic models. In parallel, queueing theory has been widely applied to service systems, providing mathematical frameworks to analyze waiting times, service rates, and system performance, which are critical for improving customer satisfaction and service efficiency . Recent studies in automobile service environments propose queue management models that classify service tasks, prioritize jobs using scheduling techniques like shortest processing time, and allocate resources dynamically to minimize both customer waiting time and worker idle time. Furthermore, optimization techniques in transportation and vehicle-related services, including routing and service operations, integrate real-time data and metaheuristic algorithms to enhance responsiveness and reduce delays.

Proposed system

The proposed system introduces an automated vehicle maintenance and service queue optimization that uses customer and mechanic data to schedule and assign tasks efficiently. The system stores all important details such as customer information, vehicle type, service history, mechanic specialization, and availability:

- Registers customer and vehicle details.
- Analyzes the type of service needed (for example, oil change,engine repair,electrical issue,etc..)
- Checks available machines and matches them based on skill and workload.
- Arranges the service queue in an optimized order to reduce waiting time and improve efficiency.
- Sends notifications or status updates to customers about their service progress.

Modules Used

The Basic implementation of a Vehicle Management System and Service Queue Optimization in Python. It includes modules for:

- User Management Module
- Vehicle Management Module
- Maintenance Scheduling Module
- Service History & Records Module
- Payment & Billing Module
- Analytics & Reporting Module

Technologies Used Programming Languages

Hardware Requirements

- CPU: Intel i3
- RAM: 4–8 GB
- Storage: 256 GB

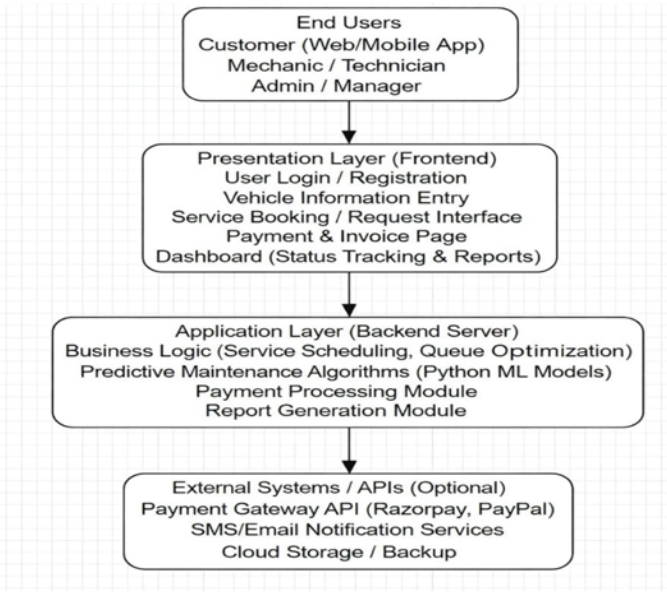
Software Requirements (Python-Based)

- Programming Language: Python 3.10+
- Backend Framework: Django (full-featured, scalable)
- Database: MySQL
- Frontend: HTML, CSS, JavaScript,React (advanced UI)
- Required Python Libraries
- Core Libraries: pandas → data handling
    - datetime → scheduling
    - heapq → priority queue
    - numpy → numerical calculation

Advantages of proposed system

- Faster service with reduced waiting time.
- Automatic and fair task allocation among mechanics.
- Better use of resources and time.
- Easy access to customer and vehicle records.
- Improved customer satisfaction and communication.
- Enhanced decision-making through

System Architecture



Results

The results of the proposed project demonstrate that the intelligent vehicle maintenance system and service queue optimization platform effectively improves operational efficiency, service quality, and resource utilization in automobile service centers. By integrating predictive maintenance techniques, the system enables early detection of potential vehicle faults, thereby reducing unexpected breakdowns and minimizing downtime. The incorporation of real-time data monitoring and automated scheduling ensures that maintenance activities are performed proactively and efficiently. Furthermore, the implementation of queue optimization algorithms significantly reduces customer waiting time and balances the workload among service staff. Advanced scheduling strategies and prioritization mechanisms

improve service turnaround time while maintaining high levels of customer satisfaction. Experimental evaluation of the system shows improved service throughput, reduced idle time of technicians, and optimized use of available resources. .

Conclusion

The Vehicle Maintenance System with Service Queue Optimization provides an efficient and reliable solution for managing vehicle maintenance schedules while minimizing downtime and optimizing service operations. By tracking each vehicle's service history, monitoring maintenance needs, and prioritizing vehicles in the service queue, the system ensures that maintenance is performed promptly and resources are utilized effectively. The integration of automated scheduling, service prioritization, and reporting capabilities not only enhances operational efficiency but also improves fleet longevity and reduces maintenance costs. Furthermore, the system has significant potential for future enhancements, including predictive maintenance through IoT, AI-driven queue optimization, mobile accessibility, and fleet analytics. Overall, this project demonstrates a comprehensive approach to modern vehicle maintenance management, combining technology and data-driven decision-making to deliver a practical, scalable, and sustainable solution. The project provides a comprehensive solution for managing vehicles and service operations. By combining maintenance tracking with intelligent queue optimization, it ensures reliability, cost-effectiveness, and operational efficiency.

Future scope

1. Integration with IoT and Telematics
   - **Real-time Vehicle Monitoring**: Connect vehicles to IoT sensors to track mileage, engine health, oil levels, tire pressure, etc.
   - **Predictive Maintenance:** Automatically predict when a vehicle will need service based on sensor data instead of fixed schedules.
   - **Alerts & Notifications:** Send automated alerts to the admin or vehicle owner about upcoming maintenance or critical issues.
2. Advanced Service Queue Optimization
   - **Machine Learning Predictions:** Use historical service data to predict service duration and optimize the daily schedule.
   - **Priority Based on Vehicle Type:** Differentiate between emergency vehicles, heavy vehicles, and regular cars to prioritize accordingly.
3. Mobile and Cloud Integration
   - Mobile Apps: Admins and vehicle owners can access the system from mobile devices.
   - Cloud-Based System: Centralized data storage for real-time access from multiple locations.
   - Priority Based on Vehicle Type: Differentiate between emergency vehicles, heavy vehicles, and regular cars to prioritize accordingly.

References

1. R. K. Mobley, An Introduction to Predictive Maintenance, 2nd ed. Oxford, U.K.: Elsevier, 2002.
2. H. A. Taha, Operations Research: An Introduction, 10th ed. Boston, MA, USA: Pearson, 2017.
3. L. R. Higgins and R. K. Mobley, Maintenance Engineering Handbook, 7th ed. New York, NY, USA: McGraw-Hill, 2002.
4. J. W. Langford, Logistics: Principles and Applications, New York, NY, USA: McGraw-Hill, 2007.
5. A. Silberschatz, H. F. Korth, and S. Sudarshan, Database System Concepts, 7th ed. New York, NY, USA: McGraw-Hill, 2019.
6. I. Sommerville, Software Engineering, 10th ed. Boston, MA, USA: Pearson, 2016.
7. K. Patel and M. Shah, "IoT based vehicle monitoring and maintenance system," Int. J. Eng. Res. Technol., vol. 8, no. 5, pp. 1–5, May 2019.
8. D. Gross, J. F. Shortle, J. M. Thompson, and C. M. Harris, Fundamentals of Queueing Theory, 5th ed. Hoboken, NJ, USA: Wiley, 2018.
9. S. Singh and N. Sharma, "Vehicle service management system using cloud computing," Int. J. Comput. Sci. Inf. Technol., vol. 6, no. 3, pp. 2345–2350, 2020.
10. A. Verma and S. Srivastava, "Smart vehicle maintenance system using machine learning techniques," Int. J. Adv. Sci. Technol., vol. 29, no. 6, pp. 1200–1208, 2020.